Rb–Sr ISOTOPIC SYSTEMATICS OF ALKALI-RICH FRAGMENTS IN YAMATO-74442 AND BHOLA.

T. Yokoyama[1], K. Misawa[1,2], O. Okano[3], C.-Y. Shih[4], L. E. Nyquist[5], J. I. Simon[5], M. J. Tappa[4], S. Yoneda[7]. [1]SOKENDAI, Tachikawa, Tokyo 190–8518, Japan. E-mail: yokoyama.tatsunori@nipr.ac.jp. [2]Ntl Inst. Polar Res., [3]Okayama Univ., [4]ESCG/Jacobs., [5]NASA-JSC, [7]Natl Museum Natural and Sci.

Introduction: Alkali-rich igneous fragments were identified in the brecciated LL-chondrites, Krähenberg (LL5) [1], Bhola (LL3–6) [2], and Yamato (Y)-74442 (LL4) [3–5], and show characteristic fractionation patterns of alkaline elements [6]. The K-Rb-Cs-rich fragments in Krähenberg, Bhola, and Y-74442 are very similar in mineralogy and petrography (olivine + pyroxene + glass), suggesting that they could have come from related precursor materials [5]. We have undertaken Rb–Sr isotopic studies on alkali-rich fragments in Bhola and Y-74442 to precisely determine their crystallization ages and isotopic signatures of their precursor material(s).

Results and Discussion: Rubidium in alkali-rich fragments from Y-74442 is highly enriched: 20–180 times those of ordinary chondrites (OC). Alkali-rich fragments from Y-74442 yield a Rb–Sr age of 4.429 ± 0.054 Ga (n = 9, error = 2σ) with an initial $^{87}Sr/^{86}Sr$ ratio I_{Sr} = 0.7144 ± 0.0094 (2σ), indicating a young crystallization age with a high I_{Sr} compared with those of LL-chondrite whole-rocks (T_{LL} = 4.542 ± 0.015 Ga, I_{SrLL} = 0.69901 ± 0.00011; recalculated with $\lambda(^{87}Rb) = 1.402 \times 10^{-11} a^{-1}$) [7].

Assuming that the precursor material enriched in Rb was formed at T_0 = 4.568 Ga with an $^{87}Sr/^{86}Sr$ ratio = 0.69888 (i.e., identical to the Allende initial $^{87}Sr/^{86}Sr$, I_{SrALL} [8]) and the fragments crystallized from the melt at T = 4.429 Ga, a time-averaged Rb/Sr ratio is calculated to be ~2.5, which is much higher than the Rb/Sr ratios of the solar nebula or CI-chondrites (Rb/Sr_{SOLAR} = 0.65 [8]; Rb/Sr_{CI} = 0.32 [9]). Any solid/liquid fractionation processes could be ruled out for K, Rb, and (Cs) enrichments since these alkali-rich fragments show flat REE patterns [6]. We suggest that a condensate from the nebular gas was a carrier of alkaline elements. It was formed from the residual nebular gas after removal of a refractory lithophile component (i.e. Sr). The temperature at which the moderately volatile component (i.e. enriched in K, Rb, and Cs) was removed from the gas was relatively high (≥970 K, the 50% condensation temperature of Na [10]). This component was isolated from other lithopiles and might have been be isolated from the nebular gas without any interaction with high/low temperature components. At 4.43 Ga the condensate was incorporated into ferromagnesian components (i.e., olivine+pyroxene) possibly during an impact melting event. They suffered further fragmentations due to impacts and then were incorporated into the LL-chondritic breccia.

References: [1] Kempe W. and Müller O. (1969) *Meteorite Res.*, pp. 418. [2] Noonan A. F. *et al*. (1978) *Geol. Survey Open File Report*, **78–701**, 311. [3] Yanai K. *et al*. (1978) *Mem. Natl. Inst. Polar Res. Spec. Issue*, **8**, 110. [4] Ikeda Y. and Takeda H. (1979) *Mem. Natl. Inst. Polar Res. Spec. Issue*, **15**, 123. [5] Yokoyama T. *et al.* (2011) *LPS XLII*, Abstract #1941. [6] Wlotzka F. *et al*. (1983) *Geochim. Cosmochim. Acta*, **47**, 743. [7] Minster and Allègre (1981) *Erath and Planet. Sci. Lett.*, **56**, 89. [8] Gray C. M. *et al*. (1973) *Icarus*, **20,** 213. [9] Palme H. (2001) *Phil. Trans. R. Soc. Lond. A 2001,* 359, 2061. [10] Wasson J. T. (1985) *Meteorite*, pp 267. Freeman, NY.